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Relationships Between Training Level, Aptitude and System Performance on the AN/TRC-170: Weighted and Unweighted Correlational Analyses

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RELATIONSHIPS BETWEEN TRAINING LEVEL, APTITUDE AND SYSTEM PERFORMANCE ON THE AN/TRC-170: WEIGHTED AND UNWEIGHTED CORRELATIONAL ANALYSES

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INTRODUCTION

With the recent MANPRINT initiative on development and evaluation of Army systems, continued interest exists in the relationship between system/soldier performance, training proficiency and Armed Services Vocational Aptitude Battery (ASVAB) scores. During 1986 and early 1987, under the auspices of the Operational Test and Evaluation Agency (OTEA), a Follow-on Test and Evaluation (FOT&E) of the AN/TRC-170 tactical troposcatter systems was conducted. The AN/TRC-170 is a family of three multichannel radio terminal sets (V1-V3) that were developed by Raytheon under contract to the Electronic Systems Division of the United States Air Force. In order to evaluate the suitability of the V2 and V3 systems for Army missions, the FOT&E was conducted. Since four Block test training proficiency measures, system performance (time) measures (obtained during the FOT&E) and ASVAB scores were available, it seemed appropriate to address the relationship among these variables. Differences in the demographic characteristics of the FOT&E and non-FOT&E soldiers in the target audience are summarized in Appendix A. Aptitude (ASVAB) differences between FOT&E and non-FOT&E soldiers are summarized in Appendix B. Finally in Appendix C, comparability of teams formed for conduct of the FOT&E is accessed via training achievement proficiency and ASVAB Composites performance.

METHOD

Dependent Variable

In preparation for the FOT&E, 27 critical tasks were identified in conjunction with set-up and operation of the V2, and 12 critical tasks were noted for the V3 operations. Many of the tasks associated with V2 and V3 are comparable and require similar task steps. When results for comparable tasks are combined, a total of 19 different tasks can be identified. The basic data (dependent variable) used in exploring the relationship among these variables (task performance, training achievement and aptitude) is task performance time. Over the entire FOT&E, performance time data was collected on 1449 occasions. Index variable $\underline{h}$ is used to define the occasion, i.e., $\underline{h}=1,1449$.

Independent Variables

Through coordination with Keesler AFB, where Additional Skill Identifier (ASI)D6 training was conducted, and ARI Headquarters, both training achievement scores and ASVAB measures were obtained. Index variable $\underline{g}$ is used to define the predictor variable; $\underline{g}=1,32$. Training achievement measures were obtained on each of the first four blocks of training for all thirty-five MOS 26Q FOT&E Operators. Each block test was composed of twenty-five multiple choice items. Data for 16 ASVAB Subtests and 11 Scaled Scores is less complete, especially for Subtests; data exists primarily for 10 Subtests. Part of this incompleteness is due to the fact that soldiers entering the service at different times have been administered different versions of the ASVAB; with subsequent versions, some Subtests have been deleted and new ones added. As indicated earlier, another reason for incompleteness seems to be due to a decision outside ARI, in some cases, to purge soldiers ASVAB Subtest scores once the Area Composites have been computed. If applied research in the real world is to be conducted, such occurrences must be met with the attitude "to do the best you can with what you have."

Method of Analysis

With a large number of variables, one methodology frequently used to better understand what relationships exist is the Pearson correlation[1]. It is well understood in research that relationships between predicted (dependent) and predictor (independent) variables are greater when there is high comparability between the measurement conditions and the content of items used to obtain both sets of measures. For this reason, stronger relationships were expected between performance time and training achievement than between performance and aptitude. The purpose of the analyses described was to find the procedure which demonstrates the best relationship possible between predicted and predictor variables. In general terms the methodology employed moved from: (1) Considering cases which show the relationship between individual predictor variables and task performance time to (2) finding the best relationship between combinations of predictor variables and performance time using stepwise regression.

Individual Predictor/Performance Time Relationships

In order to understand the procedure employed, it is important first to highlight the fact that for the 19 different critical tasks identified for data collection, most of these tasks were performed by one to four Operators on different occasions; hence the question arises how to relate one performance measure (time) to the training achievement or aptitude of one, two, three or four soldiers performing the task. Answering this question in effect leads to consideration of appropriate transformations of the basic set of independent predictor variables described above.

Independent (Predictor) Variable Definition. Among the procedures used for defining the independent (predictor) variables X for the gth predictor (e.g., block test training score, ASVAB Subtest or Composite score) on the h^{th} occasion, general definitions appear immediately below followed by specific Case definitions:

General Definition	Condition[2]
$X_{gh} = a_i x_{ig}/c_1$	task performed by one soldier (i) on occasion h
$X_{gh} = (a_i x_{ig} + a_j x_{jg})/c_2$	task performed by two soldiers (i,j) on occasion h

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[1]Generally the Pearson correlation is computed for independent pairs of interval or ratio scale observations. In the correlations computed throughout, only the performance times (dependent variable) were strictly "independent"; depending on the soldier performing each task, the same predictor (independent variable) was used.

[2]One MOS 29M and one 26Q not assigned as team Operator on occasion assisted in completion of tasks; as their ASVAB data (and for the 26Q, Block Test scores) were available, analyses included data for these soldiers on occasions in which they contributed to task completion.

General Definition (cont.)	Condition (cont.)
$X_{gh} = (a_i x_{ig} + a_j x_{jg} + a_k x_{kg}) / c_3$	task performed by three soldiers (i,j,k) on occasion _h_
$X_{gh} = (a_i x_{ig} + a_j x_{jg} + a_k x_{kg} + a_m x_{mg}) / c_4$	task performed by four soldiers (i,j,k,m) on occasion _h_

With this general definition, four specific cases for defining constants c_1, c_2 , c_3 and c_4, and weights a_i, a_j, a_k, and a_m were employed:

Case 1 (Equal Weighted Mean)	$a_i=a_j=a_k=a_m= 1$ and $c_1=1$, $c_2=2$, $c_3=3$ and $c_4=4$
Case 2 (Equal Weighted Sum)	$a_i=a_j=a_k=a_m= 1$ for all cases $i,j,k,m=1, 37$ but $i \neq j \neq k \neq m$ and $c_1=c_2=c_3=c_4=1$
Case 3 (Differential Soldier Weighted Sum)	for a_i, a_j, a_k, a_m, where $i, j, k, m = 1, 37$ but $i \neq j \neq k \neq m$ and generally $a_i \neq a_j \neq a_k \neq a_m$ and $c_1=c_2=c_3=c_4=1$
Case 4 (Differential Score Weighted Sum)	$i,j,k,m=1,37$ but $i \neq j \neq k \neq m$ _and_ when $x_{ig}=x_{jg}=x_{kg}=x_{mg}$ then $a_i=a_j=a_k=a_m$ and $c_1=c_2=c_3=c_4=1$. Generally any scores x which had the same value were assigned the same weight regardless which soldier scored that value.

Case 1 simply involved _averaging_ the scores for the predictor variable under consideration for all soldiers who participated in the task on an occasion _h_. In this case, performance time is assumed to be related to the average predictor variable score for soldiers who performed the task without regard for the variability in those scores. In Case 2, the predictor variable scores for each participating soldier were _summed_. In this case, performance is assumed to be a direct function of predictor scores of participating soldiers and the variability in those scores. This procedure assumes that each soldier's contribution to the performance time for a task is directly proportional to the particular value of the predictor variable (_g_). Case 3 requires assigning a different weight for each soldier on those tasks on which he/she participated. In this case, the assumption is made that each soldier has a unique contribution to task completion which is a function of the predictor variable (_g_) under consideration and that performance time is related to the weighted sum of predictor scores. For Case 4 a different weight is assigned for each predictor value of a predictor (_g_). For this procedure it is assumed that each predictor value is not directly proportional to its magnitude in predicting performance; however, the unique contributions of any specific predictor value is the same regardless which soldier obtained that value.

Each of these procedures has potential strengths and weaknesses. The first two procedures are simple to use and parsimonious in terms of estimation requirements but have less hope of demonstrating a relationship between performance and predictor. The first case which involves averaging is a commonly accepted way of obtaining a single predictor measure from several individuals to correlate with a single performance measure; however, compared with the second case in which the predictor measures are summed, the range of possible predictor values is smaller. Since the magnitude of the correlation between two sets of measures can be a function of the variability of scores, Case 1 would be expected to produce smaller correlational values. The third is generally the least parsimonious of the three procedures because individual weights must be estimated for each soldier; furthermore, since weights obtained are for specific soldiers, they are useful only for demonstrating the relationship between performance and aptitude/training level for these specific soldiers. However, since "fit"--all other things being equal--is generally a direct function of the number of "fitting" parameters, (of the four) this procedure would be expected to demonstrate the maximum relationship that exists between task performance time and aptitude/training level. The fourth procedure is intermediate in parsimony and, because the differential weighting is score related, weights obtained have potential value for predicting task performance for other members of the MOS 26Q population[3]. Another way of viewing these procedures for defining individual predictor variable values is as a multiple correlation procedure where soldiers and scores, (cases 3 and 4) respectively, are the independent variables.

Conventional Transformations. Before the set of correlations for each case were computed, the efficacy of more conventional transformations for Case 2 (Equal weighting) was explored for Total ASI Block Score and the ASVAB ST Composite scale. The set of transformations explored is presented in Table 1. Correlation for each of these cases served as a basis for deciding what type of transformed data, if any, would be used in subsequent analyses.

Table 1

Transformations of Predictor and Performance Time Used to Explore the Best Form of Variables to Demonstrate a Linear Relationship

		Performance Time				
		Raw	LOG_2	LOG_{10}	SQRT	ARSIN
PREDICTOR	Raw					
	LOG_e					
	LOG_{10}					
	SQRT					

Note 1. Performed for Total Block Training Score and ASVAB ST Composite Score.

[3]Development of a performance prediction model(s) would be appropriate only for validated relationships. This was beyond the scope of the current effort.

In order to compute the ARCSIN transformation of performance time, time to complete each task was first divided by the maximum time ever taken to complete that task. For both sample predictors used, correlations were highest for "Raw" (untransformed) data. Consequently all subsequent analyses utilized "raw" data.

Removal of Outliers. In order to further refine the data prior to correlational analyses, performance times which were clearly "outliers" were deleted from the data. Since the data collectors did not always record non-task related events such as beginning a task then eating or sleeping before its completion, the deletion is reasoned but admittedly based solely on the absolute value of the deviant (outlying) recorded time.

Multiple Predictor/Performance Time Relationships

A logical extension of attempting to demonstrate relationships with single predictor variables and performance is to explore the efficacy of using multiple predictors. With N as sample size and K the number of weights estimated, Herzberg (1969) indicated that for stability of multiple correlations, the N/K ratio should be about 20, i.e., there should be approximately 20 observations per weight[4]. Since the number of observations available for analysis drops sharply when considering individual tasks, any differential weighting by soldier, score or predictor creates problems in obtaining relatively stable weights. Accordingly the work reported here focuses on use of multiple predictors for all tasks with unweighted summed predictors and with differentially score weighted summed predictors (scores as defined by Cases 2 and 4). All multiple predictor analyses presented were performed with SAS using the PROC STEPWISE procedure with the MODEL option MINR. As recommended in the SAS manual for this procedure, the model selected in each case involved those set of predictor variables when the C_p statistic first approached p (the number of weights estimated--excluding the intercept).[5]

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[4]See Herzberg, P.A. The parameters of cross-validation. Psychometrika Monograph Supplement, 1969, No. 16.

[5]Mallow's criterion for selection of a "best" multiple correlation relationship involves selecting the model with the predictor variables which first lead the Cp statistic to approach p (the number of weights estimated, excluding the intercept). See SAS User's Guide: Statistics, Version 5, pp. 765-766 for more detailed discussion.

RESULTS AND DISCUSSION

Correlations Between Averaged Individual Predictors and Performance Time

Table 2 shows correlations between performance times and average training/ASVAB Composite Scores for each of 19 different tasks and over all tasks-uncorrected and *where possible* corrected for unreliability of the criterion[6]. This table also indicates the number of measurement occasions *h* and the *F* statistic to assess statistical significance of the *uncorrected* correlations. Of these 19 tasks, only EXTERNAL SHELTER SET-UP, INTERNAL SHELTER SET-UP and KLYSTRON ADJUSTMENT were covered in the first four training blocks for which training achievement scores exist. Most of the other tasks (if they were covered during formal ASI training) were covered in Block 5 for which only a GO/NO GO criterion was used. In as much as only these three tasks were trained in the first four blocks, it is reasonable to presume that the significant correlations between training achievement block scores and other tasks are probably spurious. With this rational analysis it would appear that only the correlation between Block 3 training and Klystron Adjustment performance times was truly significant [F (1,69) = 10.14, p <.01].

Of the 220 correlations involving ASVAB averaged Composites and performance time (by task and all tasks combined), 29 were statistically significant. Since 20 of those significant correlations were obtained for three tasks--INSTALL AZ/EL ASSEMBLY, ATTACH FLEXIBLE WAVE GUIDES and EXTERNAL SHELTER SET-UP, it is conjectured that characteristics of performance times distribution for these tasks played a large part in the obtained correlations. The causal relationship (if any) between the specific ASVAB Composites and performance times is unclear. Replication of these correlations for randomly formed halves would provide added support for the validity of the obtained relationships. However, the relatively low reliabilities of the performance measure makes analyses directed at the validity of relationships seemingly unproductive. For some cases, when such replication efforts would be based on rather small random sample sizes, results would probably lack stability.

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[6]Where estimates of reliability were non-negative and the square root of the reliability estimate was less than the uncorrected correlation between predictor and criterion, correlations were corrected for attenuation using the formula. $r_c = r_{xy}/\sqrt{r_{xx}}$ where r_{xy} is the uncorrected correlation between predictor and criterion variables and r_{xx} is the reliability estimate for individual task performance times or all tasks combined.

ıble 2

ignificance Tests for Unweighted Correlations Using Case 1--Average Block Test Training Scores and ASVAB Area Composite Scores

TASK		BLOCK 1	BLOCK 2	BLOCK 3	BLOCK 4	BLOCKS 1-4	AFQT	CO	FA	MM	GM	CL	GT	EL	SC	ST	OF
All	R	0.006	0.025	-.025	-.031	-.008	-.054	-.067	-.057	-.033	-.026	-.072	-.059	-.051	-.040	-.016	-.046
(.015)	R_C	.049	.204	-.204	-.253	-.065	-.441	-.547	-.465	-.269	-.212	-.588	-.482	-.416	-.327	-.131	-.376
	N	1359.	1359.	1359.	1359.	1359.	1154.	1154.	1154.	1154.	1154.	1154.	1154.	1154.	1154.	1154.	1154.
	F	0.05	0.85	0.85	1.31	0.09	3.37	5.19[b]	3.76	1.26	0.78	6.00[b]	4.02[a]	3.00	1.85	0.29	2.44
Azimuth	R	-.044	-.168	-.108	-.163	-.152	-.039	-.090	-.119	-.030	.019	-.042	-.051	.011	.041	-.046	-.111
Stake-out	R_C	-.205	-.783	-.503	-.760	-.709	-.182	-.420	-.555	-.140	.089	-.196	-.238	.051	.191	-.214	-.518
(.046)	N	52.	52.	52.	52.	52.	41.	41.	41.	41.	41.	41.	41.	41.	41.	41.	41.
	F	0.10	1.45	0.59	1.36	1.18	0.06	0.32	0.56	0.04	0.01	0.07	0.10	0.00	0.07	0.08	0.49
Antenna	R	0.296	0.243	0.295	0.322	0.340	0.184	-.146	-.013	-.059	-.140	-.056	.051	-.115	-.110	-.054	.028
Base & LPA	R_C	----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Stakeout	N	18.	18.	18.	18.	18.	14.	14.	14.	14.	14.	14.	14.	14.	14.	14.	14.
(-.015)	F	1.54	1.00	1.53	1.85	2.09	0.42	0.26	0.00	0.04	0.24	0.04	0.03	0.16	0.15	0.14	0.01
Remove	R	0.143	0.106	0.269	0.187	0.216	0.138	0.072	0.153	0.103	0.116	0.036	0.076	0.120	0.010	0.213	0.084
Transit	R_C	----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Frame	N	41.	41.	41.	41.	41.	35.	35.	35.	35.	35.	35.	35.	35.	35.	35.	35.
(-.031)	F	0.81	0.44	3.04	1.41	1.91	0.64	0.17	0.79	0.35	0.45	0.04	0.19	0.48	0.00	1.57	0.23
Truss	R	-.063	-.022	.156	.018	.039	.008	.082	.019	.068	.170	-.003	.010	.152	.055	.252	.014
Assembly	R_C	----	-.492	-----	.402	.872	.179	-----	.425	-----	-----	-.067	.224	-----	-----	-----	.313
Removal	N	39.	39.	39.	39.	39.	33.	33.	33.	33.	33.	33.	33.	33.	33.	33.	33.
(.002)	F	0.15	0.02	0.92	0.01	0.06	0.00	0.21	0.01	0.14	0.92	0.00	0.00	0.73	0.09	201.	0.01
Install	R	0.358	0.313	.382	-.158	.338	.004	.085	-.075	.243	-.044	-.354	-.226	-.114	-.044	.043	.022
Antenna	R_C	----	-----	-----	-.601	-----	.015	.324	-.286	.925	-.167	-----	-.860	-.434	-.168	.164	.084
Anchors	N	13.	13.	13.	13.	13.	11.	11.	11.	11.	11.	11.	11.	11.	11.	11.	11.
(.069)	F	1.62	1.19	1.88	0.28	1.42	0.00	0.07	0.05	0.56	0.02	1.29	0.48	0.12	0.02	0.02	0.00
Off Load	R	0.109	-.270	0.080	-.237	-.118	0.019	0.077	0.048	0.043	0.077	0.080	0.056	0.120	0.025	0.051	.016
Pallet	R_C	.359	-.890	.264	-.781	-.389	.063	.254	.158	.142	.254	.264	.185	.396	.082	.168	.053
(.092)	N	54.	54.	54.	54.	54.	42.	42.	42.	42.	42.	42.	42.	42.	42.	42.	42.
	F	0.63	4.09[a]	0.33	3.09	0.73	0.01	0.24	0.09	0.07	0.24	0.26	0.13	0.58	0.03	0.10	0.01
Base Plate	R	0.165	0.122	0.144	0.007	0.157	0.094	0.040	0.048	0.090	-.036	-.050	0.002	-.047	-.010	0.062	0.070
Installa-	R_C	.524	.388	.458	.022	.499	.299	.127	.152	.286	-.114	-.159	.006	-.149	-.032	.197	.222
tion	N	81.	81.	81.	81.	81.	68.	68.	68.	68.	68.	68.	68.	68.	68.	68.	68.
(.099)	F	2.21	1.19	1.67	0.00	2.00	0.59	0.11	0.15	0.54	0.09	0.17	0.00	0.15	0.01	0.25	0.32
Secure	R	0.210	0.046	0.100	0.109	0.139	0.087	-.038	0.044	0.027	0.027	-.007	0.039	0.040	-.023	0.093	0.035
Antenna	R_C	----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Legs	N	83.	83.	83.	83.	83.	70.	70.	70.	70.	70.	70.	70.	70.	70.	70.	70.
(-.010)	F	3.74	0.17	0.82	0.97	1.60	0.52	0.10	0.13	0.05	0.05	0.00	0.10	0.11	0.04	0.59	0.08
Install	R	-.043	-.003	-.131	-.172	-.105	0.194	0.269	0.212	0.248	0.281	0.262	0.159	0.266	0.254	0.195	0.180
AZ/EL	R_C	-.146	-.010	-.444	-.583	-.356	.658	.912	.719	.841	.953	.888	.539	.902	.861	.658	.610
Assembly	N	83.	83.	83.	83.	83.	69.	69.	69.	69.	69.	69.	69.	69.	69.	69.	69.
(.087)	F	0.15	0.00	1.41	2.47	0.90	2.62	5.23[a]	3.15	4.39[a]	5.74[b]	4.94[a]	1.74	5.10[a]	4.62[a]	2.62	2.24
Install	R	0.029	0.023	-.153	-.178	-.081	0.166	0.235	0.108	0.276	0.242	0.134	0.077	0.170	0.265	0.152	0.197
Reflector	R_C	.084	.067	-.444	-.516	-.235	.481	.681	.313	.800	.702	.388	.223	.493	.768	.441	.571
HUB	N	81.	81.	81.	81.	81.	68.	68.	68.	68.	68.	68.	68.	68.	68.	68.	68.
(.119)	F	0.07	0.04	1.89	2.58	0.52	1.87	3.86	0.78	5.44[b]	4.11[a]	1.21	0.39	1.96	4.98[a]	1.56	2.66
Install	R	-.134	-.243	-.183	-.184	-.243	-.164	-.062	-.193	-.154	-.039	0.091	-.082	-.023	-.052	-.156	-.219
Upper	R_C	-.372	-.674	-.508	-.510	-.674	-.455	-.172	-.535	-.427	-.108	.252	-.227	-.064	-.144	-.433	-.607
Pedals	N	85.	85.	85.	85.	85.	69.	69.	69.	69.	69.	69.	69.	69.	69.	69.	69.
(.130)	F	1.52	5.21[a]	2.88	2.91	5.21[a]	1.85	0.26	2.59	1.63	0.10	0.56	0.45	0.04	0.18	1.67	3.38
Install	R	0.029	0.096	0.033	-.056	0.044	0.008	-.246	-.186	-.108	-.149	-.151	0.005	-.158	-.051	-.032	-.008
Roll Yoke	R_C	.076	.250	.086	-.146	.115	.021	-.642	-.485	-.282	-.389	-.394	.013	-.412	-.133	-.083	-.021
Struts	N	85.	85.	85.	85.	85.	72.	72.	72.	72.	72.	72.	72.	72.	72.	72.	72.
(.147)	F	0.07	0.77	0.09	0.26	0.16	0.00	4.51[a]	2.51	0.83	1.59	1.63	0.00	1.79	0.18	0.07	0.00
Attach	R	-.184	0.061	-.090	0.032	-.070	-.255	-.403	-.221	-.289	-.245	-.287	-.215	-.364	-.239	-.170	-.151
Flexible	R_C	-.376	.125	-.184	.065	-.143	-.522	-.824	-.452	-.591	-.501	-.587	-.440	-.745	-.489	-.348	-.309
Waveguides	N	115.	115.	115.	115.	115.	94.	94.	94.	94.	94.	94.	94.	94.	94.	94.	94.
(.239)	F	3.96[a]	0.42	0.92	0.12	0.56	6.40[b]	17.84[c]	4.72[a]	8.38[c]	5.87[b]	8.26[c]	4.46[a]	14.05[c]	5.57[b]	2.74	2.15

Table 2 cont

Significance Tests for Unweighted Correlations using Case 1 <u>Average</u> Block Test Training Scores and ASVAB Area Composite Scores

TASK		BLOCK 1	BLOCK 2	BLOCK 3	BLOCK 4	BLOCKS 1-4	AFQT	CO	FA	MM	GM	CL	GT	EL	SC	ST	OF
Antenna	R	-.009	-.032	-.033	-.115	-.056	-.058	-.188	-.069	-.138	-083.	0.006	-.001	-.083	-.055	-.080	-.063
Erection	R_C	----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
(-.009)	N	84.	84.	84.	84.	84.	73.	73.	73.	73.	73.	73.	73.	73.	73.	73.	73.
	F	0.01	0.08	0.09	1.10	0.26	0.24	2.60	0.34	1.38	0.49	0.00	0.00	0.49	0.22	0.46	0.28
LPA	R	0.138	0.081	-.014	-.045	0.065	-.048	-.076	-.053	-.006	-.033	-.087	-.085	-.073	-.069	-.023	.012
Erection	R_C	----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
(-.012)	N	53.	53.	53.	53.	53.	48.	48.	48.	48.	48.	48.	48.	48.	48.	48.	48.
	F	0.99	0.34	0.01	0.10	0.22	0.11	0.27	0.13	0.00	0.05	0.35	0.33	0.25	0.22	0.02	0.01
External	R	0.043	0.081	0.111	0.082	0.032	-.192	-.447	-.270	-.306	-.216	-.278	-.135	-.367	-.196	-.171	-.166
Shelter	R_C	.148	.279	.383	.283	.110	-.662	-----	-.932	-----	-.745	-.959	-.466	-----	-.676	-.417	-.521
Set-up	N	65.	65.	65.	65.	65.	54.	54.	54.	54.	54.	54.	54.	54.	54.	54.	54.
(.084)	F	0.12	0.42	0.79	0.43	0.06	1.99	12.98^c	4.09^a	5.37^a	2.54	4.36^a	0.97	8.09^c	2.08	0.77	1.47
Internal	R	-.046	-.156	-.140	-.207	-.199	-.219	-.062	-.182	0.017	-.044	-.244	-.265	-.104	-.094	-.085	-.161
Shelter	R_C	-.119	-.404	-.363	-.536	-.516	-.567	-.161	-.471	.044	-.114	-.632	-.687	-.269	-.244	-.220	-.422
Set-Up	N	73.	73.	73.	73.	73.	71.	71.	71.	71.	71.	71.	71.	71.	71.	71.	71.
(.149)	F	0.15	1.77	1.42	3.18	2.93	3.48	0.27	2.36	0.02	0.13	4.37^a	5.21^a	0.75	0.62	0.50	1.88
Klystron	R	0.024	-.092	-.181	-.358	-.213	-.168	-.023	-.112	-.004	-.019	-.166	-.192	-.043	-.085	-.063	-.133
Adjustment	R_C	----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
(-.020)	N	71.	71.	71.	71.	71.	67.	67.	67.	67.	67.	67.	67.	67.	67.	67.	67.
	F	0.04	0.59	2.34	10.14^c	3.28	1.89	0.03	0.83	0.00	0.02	1.84	2.49	0.12	0.47	0.12	0.98
Antenna	R	-.070	-.071	0.006	-.009	-.077	0.058	0.058	-.018	0.134	0.124	0.020	0.006	0.134	0.093	0.066	-.063
Alignment	R_C	-.700	-.710	.060	-.090	-.770	.580	.580	-.180	-----	-----	.200	.060	-----	.930	.660	-.430
(.010)	N	60.	60.	60.	60.	60.	52.	52.	52.	52.	52.	52.	52.	52.	52.	52.	52.
	F	0.29	0.29	0.00	0.57	0.35	0.17	0.17	0.02	0.91	0.78	0.02	0.00	0.91	0.44	0.22	0.09

<u>Note 1</u>. $F = r^2/[(1-r^2)/(n-2)]$, on 1, n-2 degrees of freedom was used to test the significance of each of these correlations. See McNemar, Q. <u>Psychological Statistics</u>, John Wiley and Sons, Inc (3rd Edition), pp. 138, 274. In the Table, superscripts a = $p<.05$, b = $p<.025$ and c = $p<.01$.

<u>Note 2</u>. Estimate of criterion performance reliability was obtained using an analysis of variance approach described by Myers, J. L. <u>Fundamentals of Experimental Design</u>: Allyn and Bacon, Boston, 1967, pp. 294-299. Shelters was used as the measure of Between Subjects variance and the residual--shelters by measurement occasion interaction--the Within Subjects variance. Because of design non-orthogonality, Type III Sum of Squares produced by PROC GLM of SAS were used.

<u>Note 3</u>. R_c is the correlation between predictor and criterion variables corrected for attenuation due to unreliability of the criterion variable. In cases where the reliability estimate was negative or the square root of the reliability estimate was less than the correlation between predictor and criterion variables, no attenuation adjustment was possible.

Correlations Between Summed Individual Training Achievement Predictors and Performance Time[7]

Table 3 shows correlations for Cases 2-4 between performance time and summed Training Achievement scores (equal and differentially weighted). The remaining analyses conducted utilized summed predictor scores for all soldiers participating in a task rather than averaged predictor scores. Such a procedure tends to increase the range of values available for correlation-a circumstance which can lead to increases in the magnitude of the correlation obtained. Based on review of results presented in Table 3, it is noted that most of the correlations (unweighted and weighted) are significantly different from zero although relatively low in absolute value (all less than .21). Only for Blocks 3 and 4 does differential weighting lead to significantly larger correlations. Comparing the unweighted correlations using averages of predictors for all soldiers participating for all tasks (See Table 2) with comparable correlations using summed predictors (See Table 3) indicates that the latter values are markedly higher. No statistical tests for significance were performed for these differences. The relatively low value of these correlations in both cases is again probably due to the fact that the training achievement scores used were for the most part not measures of tasks whose performance was measured during the FOT&E.

Correlations Between Summed Individual ASVAB Subtest Predictors and Performance Time

Table 4 shows correlations for Cases 2-4 between performance time and summed ASVAB Subtest scores (equal and differentially weighted). Most of the unweighted correlations obtained are not significantly different from zero. For all but one case (where sufficient data existed), correlations based on differentially weighted score (soldier or score) were significantly different from zero. The magnitude of correlations based on differentially weighted scores involving ASVAB Subtests were larger than any of the correlations (uncorrected for attenuation) reported in Table 2 for Training Achievement data.

Correlations Between Summed Individual ASVAB Composite Predictors and Performance Time

Table 5 shows correlations for Cases 2-4 between performance times and summed ASVAB Composite scores (equal and differentially weighted). In this table all correlations are significantly different from zero. In all cases differential weighting (by soldier or score) leads to significantly larger correlations between ASVAB Composite and performance time. Score weighting over no weighting leads to significantly larger correlations for the AFQT, CO, CL, GT, EL, SC and OF Composites. Soldier weighting over score weighting leads to significant improvements in correlations for the FA, MM, GM, GT, SC, ST and OF Composites.

[7]If desired, correlations between summed unweighted individual predictors and the criterion for all tasks could be corrected for attenuation using reliability estimate r_{xx}=.015. Generally, differentially weighted predictor variable correlations exceed the reliability estimate for all tasks; therefore no correction for attenuation was meaningful.

Table 3

Pearson Type Correlations Using Unweighted and Differential Weights for Summed Individual Soldier Training Achievement Scores and Performance Times for All Tasks

	Block 1 (g=1)	Block 2 (g=2)	Block 3 (g=3)	Block 4 (g=4)	All Blocks (g=5)
r (unweighted)	.086[a] ($p<.005$)	.089[a] ($p<.005$)	.078[a] ($p<.005$)	.082[a] ($p<.005$)	.085[a] ($p<.005$)
R (different weights each soldier)	.196[a] ($p<.05$)	.177[a] ($p>.05$)	.208[b] ($p<.001$)	.197[ab] ($p<.025$)	.143[a] ($p>.05$)
weights estimated (K)	36	36	36	36	36
R (different weights each score)	.123[a] ($p<.025$)	.117[a] ($p<.01$)	.128[ab] ($p<.01$)	.130[b] ($p<.001$)	.163[a] ($p<.01$)
weights estimated (K)	9	7	9	7	18
n	1359	1359	1359	1359	1359

Note 1. See Note 1, Table 2

Note 2. $F = [R^2/(1-R^2)]\,[n-K-1]/K$, on K and n-K-1 degrees of freedom was used to test the significance of each multiple correlation. For the special case where K=1 this equation is the same as referenced in footnote 1 above. See McNemar, Q. Psychological Statistics, John Wiley and Sons, Inc. (3rd Edition), P.283

Note 3. $F = [(R_1^2-R_2^2)/(K_1-K_2)]/[(1-R_1^2)/(n-K_1-1)]$, on K_1-K_2, $n-K_1-1$ degrees of freedom was used to test the significance of difference among (multiple) correlations computed for each predictor variable. Use of this equation to compare multiple correlations with the unweighted *R* for a predictor (with $K_2=1$) is used as an approximation to assess significance of differences between multiple *R* and simple *r*. Superscripts for *r* and *R* which are the same for a given predictor indicate no significant difference ($p>.05$). No tests of significance of differences in *r* or *R* across predictors were performed (e.g. unweighted *rs* for Blocks 1 and 2 were not compared) See McNemar, Q., Psychological Statistics, John Wiley and Sons, Inc. (3rd Edition), p. 284.

Note 4. Weights were estimated by a computer algorithm utilizing "pattern search." The funtions minimized were: $1.-|r|$ or $1.-|R|$. See C.F. Wood "Recent Developments in ´Direct Search´ Techniques" Westinghouse Research Laboratories, Research Report 62-159-522-R1, 31 July 1962.

Table 4

Pearson Type Correlations Using Unweighted and Differential Weighted ASVAB Subtest Scores Summed and Performance Times for All Tasks

ASVAB Subtest	r (unweighted)	r (different weights each soldier)	weights estimated (K)	r(different weights each score)	weights estimated (K)	n
GI (g=6)	-.013 (p>.05)	(See Note 3)	9	(See Note 3)	6	45
NO (g=7)	.059[a] (p>.05)	.382[b] (p<.001)	24	.347[b] (p<.001)	17	411
AD (g=8)	-.056 (p>.05)	(See Note 3)	9	(See Note 3)	7	45
WK (g=9)	.078[a] (p>.05)	.382[b] (p<.001)	24	.359[b] (p<.001)	16	411
AR (g=10)	.075[a] (p>.05)	.382[b] (p<.001)	24	.191[a] (p>.05)	10	411
SP (g=11)	-.014 (p>.05)	(See Note 3)	9	(See Note 3)	7	45
MK (g=12)	.080[a] (p>.05)	.381[b] (p<.001)	24	.360[b] (p<.001)	16	411
EI (g=13)	.054[a] (p>.05)	-.382[b] (p<.001)	24	.257[c] (p<.05)	16	411
MC (g=14)	.052[a] (p>.05)	-.381[b] (p<.001)	24	.363[b] (p<.001)	15	411
GS (g=15)	.053[a] (p>.05)	-.381[b] (p<.01)	24	.367[b] (p<.001)	16	411
SI (g=16)	.068 (p>.05)	(See Note 3)	9	(See Note 3)	7	45
AI (g=17)	.145 (p>.05)	(See Note 3)	9	(See Note 3)	8	45
PC (g=18)	.174[a] (p<.025)	(See Note 3)	15	(See Note 4)	5	187
AS (g=19)	.116[a] (p>.05)	(See Note 3)	15	.427[b] (p<.001)	9	187
CS (g=20)	.162[a] (p<.05)	(See Note 3)	15	(See Note 3)	13	187
VE (g=21)	.120 (p>.05)	(See Note 3)	15	.345[b] (p<.001)	7	205

Note 1. See Note 1, Table 2

Note 2. See Note 2-4, Table 3

Note 3. According to Herzberg (1969) there should be approximately 20 observations per weight estimated to have reasonable confidence weights obtained are stable; no calculations were made for these variables. See Herzberg, P.A. The parameters of cross-validation. *Psychometrika Monograph Supplement*, 1969, No. 16.

Note 4. Distribution of scores for this variable was narrow (73-100) with seven of the 15 PC scores being 87; no calculations were made for this variable.

Table 5

Pearson Type Correlations Using Unweighted and Differential Weighted ASVAB Area Composite Summed Scores and Performance Time

ASVAB Composites	r (unweighted)	r (different weights each soldier)	weights estimated	r(different weights each score)	weights estimated	n
AFQT (g=22)	.078[a] (p<.01)	.258[b] (p<.001)	34	.235[b] (p<.001)	27	1154
CO (g=23)	.085[a] (p<.005)	.257[b] (p<.001)	34	.235[b] (p<.001)	24	1154
FA (g=24)	.093[a] (p<.005)	.256[b] (p<.001)	34	.188[a] (p<.025)	23	1154
MM (g=25)	.092[a] (p<.005)	.256[b] (p<.001)	34	.180[a] (p<.05)	24	1154
GM (g=26)	.094[a] (p<.005)	.257[b] (p<.001)	34	.185[a] (p<.05)	25	1154
CL (g=27)	.088[a] (p<.005	.257[b] (p<.001)	34	.222[b] (p<.001)	21	1154
GT (g=28)	.093[a] (p<.005)	.256[b] (p<.001)	34	.203[c] (p<.005)	25	1154
EL (g=29)	.091[a] (p<.005)	.255[b] (p<.001)	34	.226[b] (p<.001)	24	1154
SC (g=30)	.091[a] (p<.005)	.253[b] (p<.001)	34	.201[c] (p<.005)	25	1154
ST (g=31)	.100[a] (p<.001)	.255[b] (p<.001)	34	.183[a] (p<.01)	21	1154
OF (g=32)	.094[a] (p<.005)	.254[b] (p<.001)	34	.204[c] (p<.005)	23	1154

Note 1. See Note 1 for Table 2
Note 2. See Notes for Table 3

Correlations Between Multiple Predictors and Performance Time

Multiple predictor models developed are outlined in Table 6; analyses for these models are summarized in Tables 7-11.

Training Achievement Blocks Only

The magnitude of the multiple predictor correlation involving only unweighted Block Training Achievement scores (Table 7) was slightly larger than correlations obtained with unweighted single predictors (Table 3), about equal to those obtained with score weighted single predictors (Table 3). It was for this set of predictor variables alone that more than one predictor was entered into the multiple R when differentially weighted summed scores were used. The magnitude of this correlation (Table 7) was slightly larger than the multiple R obtained for the unweighted case and about equal to those obtained by differential score weighting for block training achievement scores as individual predictors (Table 3).

ASVAB Subtests Only

The magnitude of the multiple predictor correlation involving only unweighted ASVAB Subtest (Table 8) yielded a correlation generally larger than those obtained with unweighted single predictor Subtests (Table 4), but smaller than those obtained with either soldier or score weighted single predictor ASVAB Subtests (Table 4).

ASVAB Composites Only

The magnitude of the multiple predictor correlation involving only unweighted summed ASVAB Composites (Table 9) yielded a correlation slightly larger than those obtained with unweighted single predictor composites (Table 5) but lower than those correlations obtained with either soldier or score weighting (Table 5).

Training Achievement Blocks and ASVAB Subtests

The magnitude of the multiple predictor correlation involving both Training Achievement Blocks and ASVAB Subtests (Table 10) yielded a correlation: (1) larger than either unweighted Training Achievement Block or ASVAB Subtests when used as single predictor variables (Tables 3 and 4); (2) larger than multiple Rs using only Training Achievement Blocks (Table 7) or ASVAB Subtests (Table 8) as multiple predictors; however, (3) smaller than that obtained by differential score weighting of most ASVAB Subtests used as single predictors (Table 4); and (4) generally larger than any correlation obtained with only Training Achievement Block scores as single predictors (Table 3).

Table 6

Data Used to Develop Multiple Predictor/Performance Time Relationship

Data	Equal Weighting	Differential Score Weighting
Block Training only	Blocks 1-4 (See Table 7)	Blocks 1-4 (See Table 7)
ASVAB Subtests only	NO,WK,AR,EI MC,GS (See Table 8)	NO,WK,AR,EI MC,GS (See Table 8)
ASVAB Scaled Scores only	AFQT,CO,FA,MM,GM CL,GT,EL,SC,ST,OF (See Table 9)	AFQT,CO,FA,MM,GM, CL,GT,EL,SC,ST,OF (See Table 9)
Block Training + ASVAB Scaled Scores	Blocks 1-4 NO,WK,AR,EI MC,GS (See Table 10)	Blocks 1-4 NO,WK,AR,EI MC,GS (See Table 10)
Block Training + ASVAB Scaled Scores	Blocks 1-4 AFQT,CO,FA,MM,GM CL,GT,EL,SC,ST,OF (See Table 11)	Blocks 1-4 AFQT,CO,FA,MM,GM, CL,GT,EL,SC,ST,OF (See Table 11)

Table 7

Multiple Predictor Models Involving Equal and Differential Weighting of Block Test Training Scores Which Best Predict System Performance Time

Equal Weighting

Variable	B	F	P
Block 1	.067	2.25	<.14
Block 2	.146	7.23	<.008
Block 3	-.116	4.84	<.03
Block 4	-.082	2.40	<.13

Multiple R = .117
Cp = 5.00 n = 1359

Differential Score Weighting

Variable	B	F	P
Block 1	.005	1.48	<.23
Block 3	.003	1.04	<.31
Block 4	.004	2.92	<.09

Multiple R = .143
Cp = 3.67 n = 1359

Table 8

Multiple Predictor Models Involving Equal and Differential Weighting of ASVAB Subtest Scores Which Best Predict System Performance Time

Equal Weighting

Variable	B	F	P
NO	-.073	1.41	>.10
MK	.353	15.06	<.001
EI	-.190	5.32	<.03
MC	-.101	2.87	<.10

Multiple R = .199
Cp = 3.89 n = 411

Differential Score Weighting

Variable	B	F	P
MK	-.008	60.84	<.001

Multiple R = .360
Cp = .98 n = 411

Table 9

Multiple Predictor Models Involving Equal and Differential Weighting of ASVAB Area Composite Scores Which Best Predict System Performance Time

Equal Weighting

Variable	B	F	P
CO	-.183	14.80	<.001
ST	.209	18.08	<.001

Multiple R = .150
Cp = -2.77 n = 1154

Differential Score Weighting

Variable	B	F	P
CO	.016	67.31	<.001

Multiple R = .235
Cp = .48 n = 1154

Table 10

Multiple Predictor Models Involving Equal and Differential Weighting of Block Test Training and ASVAB Subtest Scores Which Best Predict System Performance Time

Equal Weighting

Variable	B	F	P
NO	-.158	6.13	<.02
MK	.245	9.53	<.005
MC	-.126	4.42	<.04
Block 2	.331	13.25	<.001
Block 3	-.307	12.90	<.001

Multiple R = .246
Cp = 4.81 n = 411

Differential Score Weighting

Variable	B	F	P
NO	.016	55.87	<.001

Multiple R = .347
Cp = 1.69 n = 411

Training Achievement Blocks and ASVAB Composites

The magnitude of the multiple predictor correlation involving both unweighted summed Training Achievement Blocks and ASVAB Composites (Table 11) yielded a correlation: (1) larger than either unweighted Training Achievement Block scores (Table 3) or ASVAB Composites (Table 5) when used as single predictors; and (2) larger than use of Training Achievement Blocks alone (Table 7) used as the multiple predictor set. This multiple R (Table 11), however, does not show notable improvement over the multiple R obtained only from the unweighted ASVAB Composite set (Table 9)-addition of Training Achievement Block scores to the set of potential multiple R predictors is not particularly fruitful.

Table 11

Multiple Predictor Models Involving Equal and Differential Weighting of ASVAB Area Composite and Block Test Training Scores Which Best Predict System Performance Time

Equal Weighting

Variable	B	F	P
SC	-.222	13.23	<.001
ST	.299	10.60	<.002
Block 2	.138	6.10	<.02
Block 3	-.236	10.40	<.002

Multiple $\underline{R}$ = .158
Cp = 3.41 $\underline{n}$ = 1152

Differential Score Weighting

Variable	B	F	P
CL	.015	42.99	<.001

Multiple $\underline{R}$ = .190
Cp = -.64 $\underline{n}$ = 1152

Generally, multiple predictor models do yield some improvement in the variability which can be accounted for over the single predictor case when independent variable values are not weighted. In these data it appears that the best relationships which might be useful for subsequent development of prediction models would involve differential score weighting of single predictor variables. It is recognized that while most of the obtained correlations are statistically significant, their magnitude is probably too low to make predictive model development profitable. Early in the planning for this effort, scatterplots were produced for many of the predictor variables and performance time measures. These plots showed no clear sign of curvilinear relationships. Additional data transformation might improve the obtained relationships between performance and training/aptitude. However, it also might prove fruitful to the model development effort if a data base of item (ASVAB) scores were available to permit creation of tailor-made predictor Composites for specific systems. Persuing such an effort for several systems of a given type might lead to some new Composites which would be useful for personnel selection and assignment.

CONCLUSIONS

During 1986-1987, an FOT&E was conducted on the AN/TRC-170 tactical troposcatter system at Fort Huachuca AZ. Prior to initiating this evaluation, nineteen critical tasks were identified. Throughout the test, time required to complete each task on each of several measurement occasions was obtained. Concurrent with the conduct of this evaluation, training achievement and Armed Services Vocational Aptitude Battery (ASVAB) data were obtained for each participating system operator. These data were used in a series of correlational analyses to determine what relationship exists between system performance (the criterion), training proficiency and soldier aptitude (ASVAB)--the predictors. Analyses included unweighted (Pearson) correlations of individual task performance times with training proficiency and ASVAB Composites and Subtest scores as well as differentially weighted soldier and predictor scores for all tasks.

Although reliabilities of the critical measures were generally quite low, most of the obtained correlations between criterion and predictors (except unweighted correlations involving ASVAB Subtests scores) were statistically significant. Unweighted correlations rarely exceeded .10--never .20. Weighted correlations involving training proficiency and system performance ranged from .117 to .208. Weighted correlations involving ASVAB Composites ranged from .180 to .258; for ASVAB Subtests the range was .191 to .427 . Differential weighting of training proficiency measures led to significantly higher correlations over unweighted correlations in only two of ten cases. For ASVAB Composites, differential weighting led to significantly larger correlations in 18 of 22 cases; for ASVAB Subtests 15 out of 16 were significantly larger. Generally, multiple correlations involving training and aptitude measures did not lead to correlations notably larger then those obtained by weighting individual predictor variables.

APPENDIX A

TARGET AUDIENCE DEMOGRAPHIC CHARACTERISTICS FOR FOT&E AND NON-FOT&E SOLDIERS

Table A1 below summarizes demographic characteristics of FOT&E and non-FOT&E MOS 26Q soldiers. Data presented below was obtained during Operator interviews at completion of the FOT&E.

While data presented in Table A1 are no doubt dated, there is no reason to presume a bias favoring either the FOT&E or non-FOT&E soldiers. Review of Table A1 indicates that the FOT&E soldiers are generally lower in paygrade, significantly younger than the non-FOT&E soldier and with significantly less time in their MOS. The distribution of education attained by these two groups is roughly comparable.

Table A1

Demographic Characteristics of FOT&E and Non-FOT&E MOS 26Q Soldiers

Characteristic	FOT&E n	FOT&E %	Non-FOT&E n	Non-FOT&E %
Paygrade				
E-1	7	20.59	134	6.51
E-2	1	2.94	81	3.94
E-3	19	55.88	318	15.46
E-4	4	11.77	749	36.41
E-5	3	8.82	485	23.58
Education				
High School (3 yrs)	1	2.94	37	1.80
High School Grad	31	91.18	1481	72.07
1 Year College	1	2.94	111	5.40
2 Years College	1	2.94	49	2.38

	FOT&E n	FOT&E $\bar{X}$	FOT&E SD	Non-FOT&E n	Non-FOT&E $\bar{X}$	Non-FOT&E SD
Age	34	20.88	2.91	1832	24.26	4.47
	t=-6.63, df=1864, p<.01 (two tailed)					
Time in MOS	34	28.79	31.14	1832	51.27	34.96
	t=-3.72, df=1864, p<.01 (two tailed)					

APPENDIX B

APTITUDE (ASVAB) DIFFERENCES BETWEEN FOT&E AND NON-FOT&E SOLDIERS

As with demographic characteristics discussed in the preceding section, aptitude differences also represent a class of variables which permit inferences about sample representativeness. When evaluating a system, it is desirable to select a sample which "mirrors" the population from which it is selected if one wishes to generalize the findings to that population. Analyses of the sort presented in the preceding section, and here, provide a basis for assessing whether task performance attained is or is not what could be expected of other members of the population. Table B1 below summarizes aptitude difference of FOT&E and non-FOT&E soldiers by comparing Area Composite measures.

Review of Table B1 indicates that for each ASVAB Aptitude Area Composite, FOT&E soldiers score significantly higher than non-FOT&E soldiers. These findings imply that soldiers selected to participate in the FOT&E as Operators are generally superior to those found in the MOS 26Q population. To the extent performance on the AN/TRC-170 system is related to ASVAB aptitude, one would infer that test performance obtained represents a "best case" condition.

Table B1

ASVAB Scaled Scores for FOT&E and Non-FOT&E MOS 26Q, Soldiers[1,2]

	FOT&E			Non-FOT&E		
Area	n	X	SD	n	X	SD
AFQT	33	65.18	20.93	2027	52.19	21.54
			$t=3.44, df=2058, p<.01$			
Combat (CO)	33	115.48	14.30	1737	104.39	14.74
			$t=4.29, df=1768, p<.01$			
Field Artillery (FA)	33	115.12	13.52	1734	104.17	13.28
			$t=4.69, df=1765, p<.01$			
Motor Maintenance (MM)	33	114.21	12.35	1746	107.46	13.30
			$t=3.02, df=1777, p<.01$			
General Maintenance (GM)	33	113.82	13.07	1748	105.50	13.87
			$t=3.42, df=1779, p<.01$			
Clerical (CL)	33	109.12	13.34	1747	101.10	13.19
			$t=3.46, df=1778, p<.01$			
General Technical (GT)	33	110.55	12.97	1875	103.90	13.86
			$t=2.73, df=1906, p<.01$			
Electronics (EL)	33	114.42	12.42	1738	106.65	12.22
			$t=3.62, df=1769, p<.01$			
Surveillance/Communications (SC)	33	111.76	13.20	1745	101.82	13.18
			$t=4.29, df=1776, p<.01$			
Skilled Technical (ST)	33	114.33	12.01	1759	104.37	13.74
			$t=4.14, df=1790, p<.01$			
Operators/ Food (OF)	33	111.24	11.83	1733	104.36	14.45
			$t=2.72, df=1764, p<.01$			

Note 1. All *t* tests are two-tailed.

Note 2. Special thanks are extended to Ms Francis Grafton, Data Base Management Project Leader in the Manpower and Personnel Policy Research Group for providing demographics and ASVAB aptitude data of both FOT&E and non- FOT&E soldiers.

APPENDIX C

TEAM COMPARABILITY ON TRAINING ACHIEVEMENT AND APTITUDE

Apart from representativeness of FOT&E soldiers to the entire MOS 26Q population, it is also relevant and of interest to understand whether any differences in training achievement attained or ASVAB (aptitudes) exist among the five teams formed to perform system set-up/operation/tear down tasks during the FOT&E. Means and standard deviations together with one factor analyses of variance addressing differences among Teams on each Training Block Score and each ASVAB Subtest and Area Composite Score are presented in Table C1 below. Review of these data first reveal that for many of the ASVAB Subtests, especially, data were not available for many FOT&E soldiers. Discussion with the Data Base Management Project Leader at ARI Headquarters indicated that once Composite Scores are formed from Subtests, in many cases a decision outside ARI is made to purge Subtest scores from the soldiers' file. Given this limitation on data available, it seems clear that except for the MC Subtest, Teams are not significantly different in aptitudes captured by the ASVAB. With this many statistical tests performed, it quite possible that this obtained difference was a chance finding.

Table C1

Comparison of Training Achievement and ASVAB (Aptitude) Performance of FOT&E Operator (MOS 26Q) Teams

Training/ Aptitude Measure	Team 1 (n=7)			Team 2 (n=7)			Team 3 (n=7)			Team 4 (n=7)			Team 5 (n=7)			Significance Test
	n	$\bar{X}$	SD	n	$\bar{X}$	SD	n	$\bar{X}$	SD	n	$\bar{X}$	SD	n	$\bar{X}$	SD	F Statistic
ASI Training [2]																
Block 1	7	80.00	8.64	7	81.71	7.61	7	87.43	12.74	7	83.43	11.87	7	84.00	10.33	$F(4,30)<1, p>.05$
Block 2	7	92.00	6.11	7	86.86	8.86	7	90.86	5.52	7	87.43	7.09	7	92.57	3.60	$F(4,30)=1.16>.05$
Block 3	7	82.86	9.72	7	78.86	9.72	7	81.14	9.15	7	77.71	10.55	7	81.71	10.80	$F(4,30)<1, p>.05$
Block 4	7	91.43	6.29	7	88.00	8.64	7	94.29	4.54	7	90.29	6.05	7	88.00	8.33	$F(4,30)=1.01, p>.05$
All Blocks (Sum)	7	346.29	24.75	7	335.43	20.45	7	353.71	22.13	7	338.86	29.64	7	346.29	20.11	$F(4,30)<1, p>.05$
ASVAB Subtests [3]																
General Information (GI)	0	-----	-----	3	60.00	7.00	1	53.00	-----	2	70.00	4.24	2	70.00	14.14	$F(3,4)=1.32, p>.05$
Numerical Operations (NO)	3	88.00	10.39	6	74.00	8.94	6	79.67	14.39	3	64.67	29.48	5	81.60	14.93	$F(4,18)=1.06, p>.05$
Mathematical Knowledge (MK)	3	88.00	12.00	6	77.50	16.12	6	75.17	11.50	3	68.00	20.42	5	77.60	27.80	$F(4,18)<1, p>.05$
Electronics Information (EI)	3	78.33	20.82	6	67.67	15.91	6	69.50	10.65	3	61.67	10.41	5	74.80	19.06	$F(4,18)<1, p>.05$
Mechnical Comprehension (MC)	3	85.33	10.07	6	64.67	14.22	6	80.50	15.80	3	50.67	10.07	5	76.80	19.28	$F(4,18)=3.00, p<.05$
General Science (GS)	3	85.33	4.62	6	66.33	14.51	6	65.00	18.75	3	74.00	18.52	5	79.20	17.01	$F(4,18)=1.24, p>.05$
Shop Information (SI)	0	-----	-----	3	73.33	20.21	1	70.00	-----	2	47.50	3.54	2	72.50	24.75	$F(3,4)<1, p>.05$
Automotive Information (AI)	0	-----	-----	3	60.00	22.91	1	75.00	-----	2	37.50	17.68	2	60.00	28.28	$F(3,4)<1, p>.05$
Paragraph Comprehension (PC)	3	84.67	4.04	3	82.33	8.08	5	89.40	7.50	1	87.00	-----	3	91.00	3.46	$F(4,10)<1, p>.05$
Auto/Shop Information (AS)	3	69.33	22.74	3	61.33	23.44	5	68.80	17.53	1	60.00	-----	3	88.00	14.42	$F(4,10)<1, p>.05$
Coding Speed (CS)	3	69.00	5.57	3	60.00	3.61	5	68.20	18.89	1	73.00	-----	3	70.33	11.06	$F(4,10)<1, p>.05$
Verbal (VE)	3	86.67	7.57	3	76.67	15.01	5	86.00	6.63	1	90.00	-----	4	80.00	10.71	$F(4,11)<1, p>.05$
Attention to Detail (AD)	0	-----	-----	3	48.67	16.92	1	43.00	-----	2	48.50	12.02	2	50.00	14.14	$F(3,4)<1, p>.05$
AFQT Subtests																
Word Knowledge (WK)	3	87.33	9.07	6	69.33	20.84	6	76.50	20.18	3	64.00	23.64	5	77.60	11.59	$F(4,18)<1, p>.05$
Arithmetic Reasoning (AR)	3	93.67	5.77	6	78.67	9.20	6	85.67	18.78	3	73.33	15.28	5	76.40	23.82	$F(4,18)<1, p>.05$
Space Perception (SP)	0	-----	-----	3	76.67	7.64	1	90.00	-----	2	60.00	21.21	2	80.00	28.28	$F(3,4)<1, p>.05$
ASVAB Area Composites [4]																
AFQT	6	76.33	11.62	7	60.57	16.13	7	66.29	22.50	5	61.40	30.51	7	65.00	24.34	$F(4,27)<1, p>.05$
Combat (CO)	6	120.83	11.21	7	111.86	13.36	7	118.43	14.86	5	107.60	16.65	7	118.29	16.66	$F(4,27)<1, p>.05$
Field Artillery (FA)	6	120.67	11.94	7	111.71	11.10	7	116.71	17.53	5	111.40	10.45	7	115.43	17.04	$F(4,27)<1, p>.05$
Electronics (EL)	6	120.83	10.48	7	114.29	11.06	7	114.57	8.79	5	107.40	18.08	7	116.57	13.53	$F(4,27)<1, p>.05$
Operator/Food (OF)	6	118.00	8.65	7	105.00	12.64	7	112.57	11.60	5	106.00	10.17	7	115.57	12.87	$F(4,27)=1.57, p>.05$
Surveillance/ Communications (SC)	6	117.67	9.37	7	110.43	11.39	7	110.57	11.89	5	107.60	16.83	7	114.29	17.31	$F(4,27)<1, p>.05$
Motor Maintenance (MM)	6	119.83	11.62	7	110.71	13.25	7	114.71	11.35	5	104.80	6.06	7	120.57	13.69	$F(4,27)=1.79, p>.05$
General Maintenance (GM)	6	118.67	12.36	7	113.86	13.74	7	112.14	8.07	5	109.60	12.28	7	117.14	17.58	$F(4,27)<1, p>.05$
Clerical (CL)	6	113.67	7.34	7	109.86	13.18	7	106.71	16.82	5	107.80	18.59	7	109.29	13.03	$F(4,27)<1, p>.05$
Skilled Technical (ST)	6	120.17	8.18	7	111.86	11.84	7	114.00	9.83	5	114.00	12.02	7	115.43	16.20	$F(4,27)<1, p>.05$
General Technical (GT)	6	117.13	6.12	7	109.43	10.86	7	111.57	16.50	5	108.20	16.59	7	108.71	13.95	$F(4,27)<1, p>.05$

1 Five sites were operational at a time—two shelters (a V2 and V3 for Teams 1-4; two V2s for Team 5) per site. Three operators were assigned to a shelter with a Section Chief (MOS 26Q) supervising operations for colocated shelters at a site.

2,3 Percentage of total items correct--25 total for Additional Skill Identifier (ASI) Block Tests, varies for ASVAB Subtest (Scales and versions of ASVAB)

4 Scaled Scores